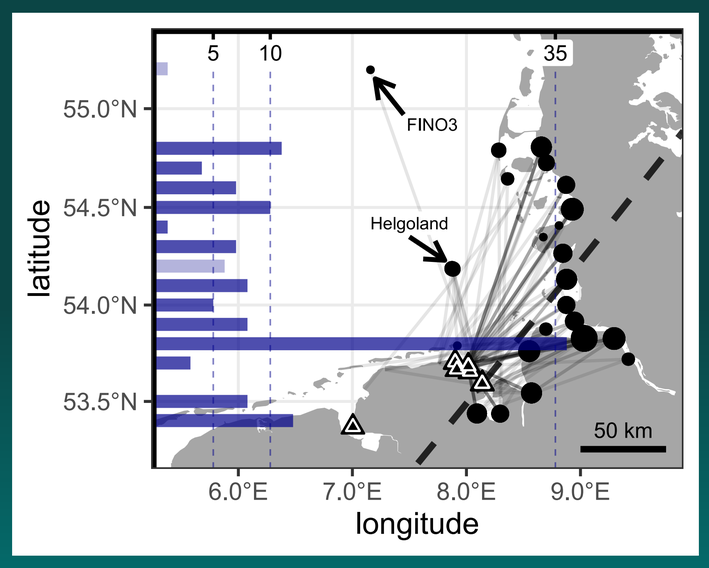
Migration timing during spring depends on **migration distance**, while individual adjustments of **departure and routing decisions** are similar.



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Migratory decisions in birds with different migration strategies during spring

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Introduction

Bird migration is defined by a sequential series of **trade-off decisions**, including departure, routing, and landing decisions. In combination, these three aspects shape the spatio-temporal patterns of an individual movement, and are thus directly linked to the distance travelled per time unit and to energy consumption, i.e. cost of transport under variable environmental conditions. (Schmaljohann, Eikenaar, and Sapir 2022).

Individual migratory decisions during autumn migration likely depend on **migration strategy**, i.e. short- to medium- or long-distance migrants, and birds of both strategies differently react to prevailing environmental conditions at stopover (Packmor et al. 2020). However, it remains unclear whether migration strategy similarly affects the adjustment of migratory decisions during spring, when early arrivals at the breeding grounds should be mutually beneficial for individual reproductive fitness.

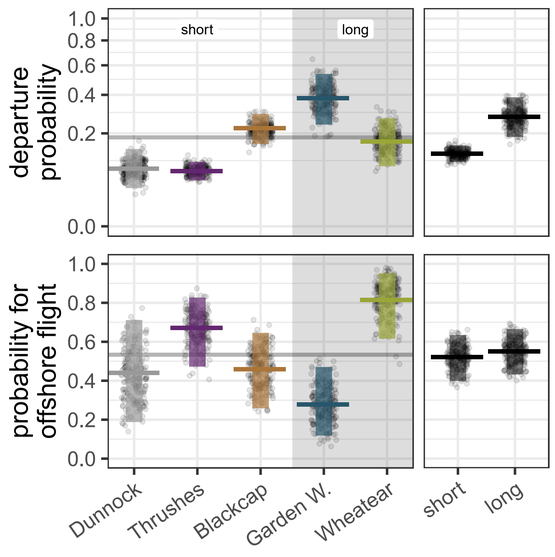
Objectives

1. Do departure and routing decisions differ between migration strategies in spring?
2. How many birds cross the German Bight?
3. Does migration strategy affect how birds adjust migratory decisions?

Methods

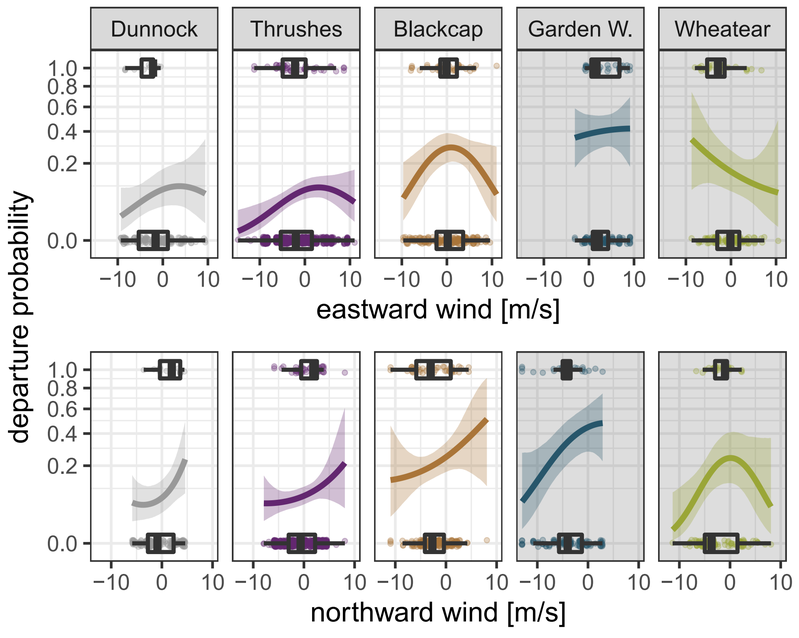
We equipped 289 songbirds of seven species from both migration strategies with radio tags at coastal stopover sites along the German North Sea coast during spring and tracked them by means of an automated receiver network. Once departed, birds could either cross the German Bight or take a detour along the coast. Using a hierarchical multistate model, we estimated weather effects on daily migratory decisions, i.e. day-to-day departure decisions in concert with routing.

Results

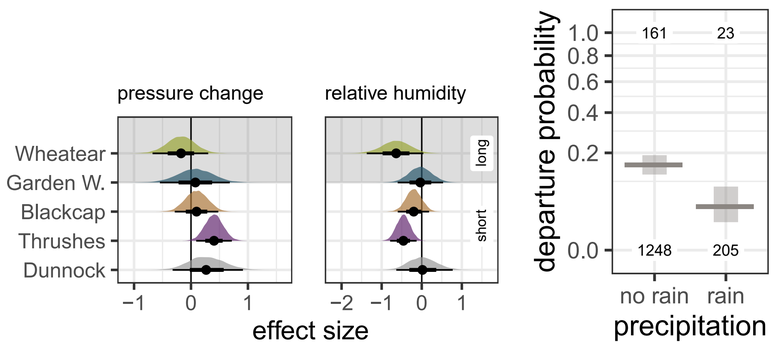


Short- to medium-distance migrants departed 5.9 days (3.5–8.8 days) later than long-distance migrants, resulting in higher departure probabilities. The mean probability for an offshore flight differed between species but not migration strategies.

1. Day-to-day departure probability among species was higher in long-distance migrants independently from routing decision.
2. We estimated that 56% (95% CrI: 47.8–58.2 %) of all birds crossed the German Bight.

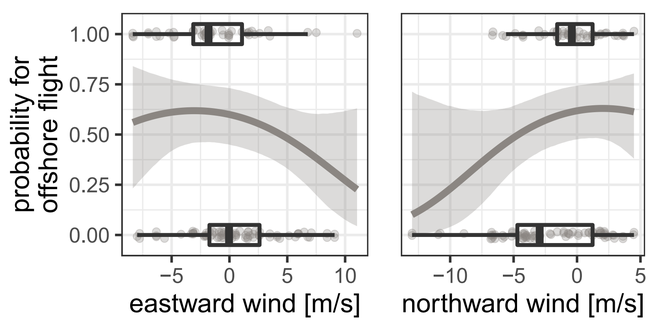


Birds more likely departed under westerly winds (easterly winds in Northern Wheatears) and light southerly winds.



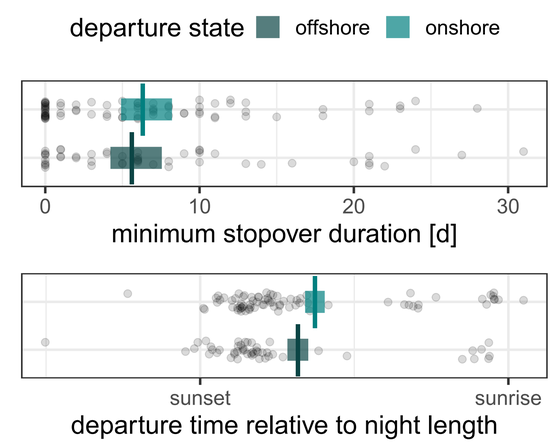
The influence of air pressure change and low relative humidity differed between species but not migration strategy.

Birds more likely departed during times with no precipitation.



Routing was predicted by both wind components with higher probabilities for an offshore flight under easterly and southerly (offshore) winds peaking at low wind speeds.

3. We found no consistent differences in reaction norms to prevailing environmental conditions between migration strategies.



Birds that followed the coastline departed 0.7 days (-1.8–3.1 days) later than birds that flew offshore. Within the day of departure, onshore flights started 5.6% of night length (2.1–9.2 %) later compared to offshore flights.

Conclusion

Studying proximate mechanisms on individual departure and routing decisions in concert, our results suggest that migration timing during spring inherently depends on migration strategy, while individual weather related adjustments of migratory decisions are similar between strategies. We therefore suppose that, despite high individual en route flexibility, selection similarly affects birds of different migration strategies during spring in favour of early arrivals at the breeding grounds. These findings may also be of general importance to migratory animals, e.g. insects, but more studies on other migrant species and at other stopover sites are required to draw firm conclusions.

References

Packmor, Florian, Thomas Klinner, Bradley K Woodworth, Cas Eikenaar, and Heiko Schmaljohann. 2020. "Stopover Departure Decisions in Songbirds: Do Long-Distance Migrants Depart Earlier and More Independently of Weather Conditions Than Medium-Distance Migrants?" *Movement Ecology* 8 (1): 1–14. https://doi.org/10.1186/s40462-020-0193-1.

Schmaljohann, Heiko, Cas Eikenaar, and Nir Sapir. 2022. "Understanding the Ecological and Evolutionary Function of Stopover in Migrating Birds." *Biological Reviews*. https://doi.org/10.1111/brv.12839.

* Map indicating locations of tag deployment (triangles) and receiver stations where birds arrived after a migratory endurance flight (dots, size equals to the number of individuals). The histogram on the left summarises the number of individuals detected per 0.1°. Offshore detections on Helgoland and FINO3 are given in light colours. Dashed black line indicates threshold latitude and longitude for flight categorisation as offshore (to the left) or onshore (to the right) flight.

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